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AN ATTEMPT TO EXPLAIN THE PERIODICITY OF FEVERS.

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THOUGH not generally admitted by physicians, the seminal propagation of disease has long been a popular idea. Before the introduction of inoculation into Europe, the communication of the disease by inserting cotton dipped in variolous matter into the nostrils was termed *sowing* the smallpox.* From the appearance of warts and other tumors, some of which diffuse peculiar odors, it was supposed that animal bodies might, besides supporting the numerous varieties of epizoa and entozoa, serve also as a soil for vegetable-like parasites.†

The terms seeds of disease and roots of disease, seem to have been regarded as mere vulgar expressions until 1837, when Bassi announced that muscardine in the silk worm was produced by a fungus, the most minute portion of which could communicate the disease to a whole colony. In the same year Cagniard Latour ascertained that fermentation is not a mere inanimate process, but that it depends on the decomposition of organic fluids by minute fungi, which consist of small granules, either singly, or in rows containing from two to eight. During fermentation the granules contract and emit spores, from which, when they have attained the size of the parents, shoots again proceed.‡ According to Schwann it is thirty-six hours before a few of these fungi are observed in freshly expressed grape-juice; but when once they begin to form, or when they are added as yeast, their propagation is rapid. The little chemists soon effect an entire change in the composition of the liquid, and only cease their labors when nourishment is exhausted, or they are destroyed by the alcohol they produce. The potato disease, the ravages of which have been so extensive, has been found to be owing to a similar cause. After the root is softened and destroyed by the successive propagation of fungi, it is farther decomposed by animalculæ; it is consequently concluded that the vinous and putrefactive changes are solely the results of vital chemistry; the former being a vegetable and the latter an animal process. In 1839, Schonlein dis-

* Moore's History of the Smallpox.

† Muhry Ad paraselorum malignorum historiam symbolæ aliquot. Gotting., 1833.

‡ Henle Pathologische Untersuchungen. Berlin, 1840.

covered the fungous character of porrigo favosa, which was afterwards traced to the mouse. In 1840 Greely, and afterwards Berg, ascertained that the fungi constituting aphthæ could be propagated not only from one infant to another, but could also be re-produced on artificial solutions of organic matter.

The first application of the above-mentioned facts to the explanation of the phenomena of disease, was made in 1840 by Henle, who divides endemics and epidemics into three groups.* The first contains intermittent fever, which, he considers, arises from miasma alone. The second contains those diseases which appear as miasmatic, and which are also propagated by contagion. There is probably, he observes, a transition between these groups; for remittent fever seems to be developed from the intermittent, and it is difficult to establish the limits between gastric and yellow fever, or even typhus, and between catarrhal fever and influenza in their contagious forms. If essentially different processes of disease were not comprehended under the same name, he thinks that remittent fever would prove that a disease might commence from miasma and in the course of development become contagious. In the third group he classes those diseases which arise from contagion only, and which, as far as is known, are never miasmatic.

Henle assumes that contagious diseases are produced by vegetable or animal parasites, causing inflammation, as in the exanthemata, when of the former character; and putrefaction, as in hospital gangrene, when of the latter. Of the exanthemata he observes, "The disease commences with the reception of the parasites or their germs. The reception occurs only on mucous membranes as far as they are penetrable from without, or on abraded portions of the skin, frequently on definite regions, as certain epizoa and entozoa prefer particular parts of the body."†

"The inflammation which the contagion has occasioned is more or less superficial, and afterwards the exudation appears, either equally, as simple inflammation, or in the form of separate papulæ, vesicles or pustules."‡

"The inflammation spreads from the place where the affection first occurred, and this may be accomplished in three ways. 1. The parasites, as if growing exuberantly, spread over the body, proceeding either over or under the cuticle; at the same time in most diseases they descend into the lungs, and also, but less frequently, into the intestines. 2. The spreading of the inflammation may be derived from the sympathetic irritation of those portions of the skin to which the parasites do not extend. 3. The distribution may be effected through the blood." "As already remarked, there is no reason for holding the absorption of contagion through the blood as necessary and essential, and just as little for denying its possibility in certain cases."||

"Fever, and what are called general symptoms, may proceed from a double origin. 1. The fever is the consequence of local inflammation, as it also accompanies other inflammations which are not miasmatic.¶

* *Pathologische Untersuchungen*, § 3, 4, 5. † *Idem*, § 23. ‡ *Idem*, § 24. || *Idem*, § 27.

2. The change of the blood, or of the organic material at the expense of which the supposed parasites increase, may be the cause of fever.*

"It is asserted that from an intermittent epidemic or endemic, a contagious disease may be gradually developed, and that gastro-nervous, mucous and yellow fevers, belong to diseases which, under certain circumstances, proceed by degrees from endemic intermittents, and then at their height, form contagion.†" Thus contagious Egyptian may proceed from simple catarrhal ophthalmia, and contagious dysentery and cholera from simple diarrhœa.

Henle endeavors to explain the transformation of intermittents into contagious typhus and yellow fever, in the following way. "1. We may assume that the infecting matter, as in miasmatic contagious diseases, lives or is at least maintained without the animal organism; that a healthy body is not the soil suited for its development; but that a pathological change must have preceded in order that it may grow.‡" "By marsh air, by sulphuretted hydrogen, negative electricity, or any other cause, intermittent fever is produced; by the intermittent the chemical constituents of the blood or other fluids become altered; by this alteration the individual is adapted to receive and support living bodies floating in the atmosphere, which then occasion a new form of disease, and at last the latter may proceed farther as a contagious disease."|| Or, 2, we may grant a spontaneous origin of the infecting matter in patients."

Henle's treatise contains much interesting matter, and extends to 82 pages. It is my intention, in the present communication, rather to state my own views than to comment on the opinions of others.

As the existing theories of epidemics were, to me at least, unintelligible, I adopted the doctrine of the propagation of disease according to the laws of organic life, long before the discoveries of Andouin and Schonlein; yet nothing occurred to induce its publication until August, 1845, when I received a circular from the committee appointed by the Legislature to investigate the quarantine laws of the port of New York. A short account of my views was hastily made out and sent to the editor of this Journal, in which it appeared on the fifth of September of the same year. At that time I knew nothing of what had been done by Andouin and Schonlein.

Before making any remarks on epidemic diseases, I shall offer a few observations on

1. *Hectic Fever*.—Abnormal pressure at or near the extremities of nerves, as a foreign body in the eye, a splinter under the nail, parasites in the skin or bowels, the formation of pus, or the pressure of inflamed and thus dilated vessels, produces fever. If we admit, as we may from various phenomena, that while awake, the extremities of the nerves are in a certain state of erectility, the relaxation which occurs during sleep will bring them more closely in contact with pus or other foreign matter, and thus produce that re-action of the nervous and vascular systems which constitutes fever.

* Path. Unters., § 30. † Idem, § 59. ‡ Idem, § 61. || Idem, § 62.

2. *Exanthemata*.—It is assumed that the seeds of the exanthemata are received into the blood by the air passages, and deposited in the skin and mucous membranes; and that each elevation is a living vegetable-like individual, which grows and yields its seed, and after the period allotted to its existence withers away. The exanthemata vary not only in the degree of local irritation, but also in the constitutional effects of the poison they themselves produce; thus some of them show merely inflammatory symptoms; whereas others, as typhus fever, exhibit little irritation, but much poisonous effect. The virus of the latter is so strong, that in the neighborhood of the parasites the blood is decomposed, and leaves depositions of extravasated fluid, forming petechiæ and vibices.

Disease producing parasites may be propagated on bodies exterior to the individual capable of being infected. Andouin and Montague ascertained that the fungi of muscardine could grow on damp moss, and even on inorganic bodies. Dr. Fell, of New York, observed on the face and scalp of individuals a species of tineæ, which was produced by parasitic animalculæ abounding on the leaves of the paper mulberry. There is reason to believe that typhus can be propagated in a similar manner, as it is said that it can be traced to the inhabitants of a peat bog district situated in certain latitudes, and that it is unknown in tropical regions. Nothing is known of the other exanthemata being thus produced.

3. *Intermittent Fever and Hooping Cough*.—The following observations of Schonlein* may serve as the basis of an explanation of the periodicity of intermittents. It is hoped that they may receive the attention of pathologists in America, where periodical diseases are more frequent than in Europe.

After noticing the obscurity of our knowledge of the pathology of this class of diseases, and the few opportunities he has had for *post-mortem* examination, Schonlein remarks that the liver and spleen have been found morbidly affected, but observers have entirely neglected the examination of the parts which principally participate in the phenomena. "In a patient who had been formerly long treated here in the hospital, and who afterwards died of epilepsy, there were found along the plexuses surrounding the aorta peculiar secondary formations, from the size of a lentil to that of a pigeon's egg, which were very similar to tubercular masses, and which by compressing the nerves and ganglia of the abdomen had occasioned the epilepsy. We have observed similar appearances on the phrenicus and vagus in tussis convulsiva. These secondary formations were arranged like a rosary, and strikingly brought to mind the deposits on the conducting wires of a galvanic battery."

If we consider the irritation produced by a foreign body, not larger than a grain of sand, upon a nerve, we must acknowledge the difficulty of confirming the observations of Schonlein; especially if that body be of the color of most tubercular concretions, which is that of the nerves themselves. We cannot wonder, therefore, that similar deposits have escaped the notice of other pathologists. Until more satisfactory data are furnished, I shall assume that intermittent fever is caused by inhaling

the spores of a fungus growing on decomposing organic matter ; that the spores are received into the circulation and deposited on branches of the sympathetic ; that the periodical development of these deposits occasions the chills and vascular re-action ; that the symptoms cease when the nerves are accustomed to the foreign body, and are again renewed by another development, which in tertians occurs every third day, just as spores have been observed to form always on the fourth day in the fungus of muscardine.

The difference between intermittent fever and whooping cough seems to be this :—the development of the parasites in the former is regular, and in the latter irregular ; the pressure of foreign bodies in or near the nerves of the lungs occasions efforts to throw them off by convulsive expirations ; in irritation of the sympathetic, when it is first acted on by pus, as in abscesses of the liver and spleen, chills and fever are more decided than in suppuration of any other organ : intermittents are the result of indigenous parasites ; whooping cough is the result of occasional visitors, which sweep along a country, and are sometimes intercepted by mountains and woods.

Contagious and non-contagious diseases differ in this respect : in the former the parasites are propagated on the skin and mucous membranes, and their minute shoots or spores when developed, diffused through the surrounding atmosphere, or otherwise brought in contact with surfaces capable of being infected ; in the latter the spores are detained in the fluids, and are probably decomposed before they are evacuated.

4. *Hydrophobia*.—It is generally admitted that diseases, as well as plants and animals, become altered by circumstances. Variola, after having passed through the cow, becomes vaccinia ; the solanum tuberosum, which is poisonous in its original state, becomes wholesome by cultivation ; and the working bee can be converted into a queen. We may therefore infer that animal or vegetable parasites, which are innocuous in one class of animals, may be fatal to others.

If there be any truth in the report that the tartar on the teeth consists of the microscopic shells of animalculæ, we must infer that animalculæ are contained in the saliva ; and it is as reasonable to suppose that animalculæ can be propagated in the secretions of the salivary glands as in those of the testis. When the salivary animalculæ of another animal are introduced into the blood of a dog, they will find their way into the salivary glands ; the exotics may produce no unfavorable symptoms till their development, when they become a source of irritation, producing sublingual pustules, spasm of the œsophagus, and the other distressing symptoms of hydrophobia. The animalculæ thus altered may, when proceeding from the dog, be not only more readily absorbed and propagated, but also more virulent than those of other animals.

This apparent resuscitation of the popular notion of hydrophobia arose from reading the above account of the microscopic appearances of tartar, and the experiments of Dr. Wright, who found that after injecting his own saliva into the jugular veins of dogs, the animals appeared to have completely recovered from the injury, but afterwards became rabid ; whereas no secondary effect was produced by injecting artificial solutions

I have thus endeavored to show that the exacerbations of epidemic diseases arise from the periodical development of vegetable or animal parasites, as the periodical flow of the catamenia arises from the maturation and emission of an ovum; and that the symptoms vary with the functional peculiarities of the nerves affected.

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SENSITIVE ATTRACTION.

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SENSITIVE attraction is the principle which organizes inorganic matter. If you cut off a slip of willow, currant bush, or Chinese mulberry, and insert it in the moist earth, a new organization immediately results. Roots are immediately called out of that part of the slip in contact with the earth and its contents. This new organization takes place from the attraction of the living stem, or of the particles of the stem, for earth and its contents. Bring these substances in contact, and the new form takes place. From a section of stem or shoot a new organ or set of organs is produced, performing a function or an office entirely different from the part of the tree it proceeds from. The roots are a new form of vegetable matter, necessary to the existence of the tree or plant. Separate the substances, and the twig dies. In the immensity of natural phenomena, perhaps there is none more wonderful than this, which shows the great diversity of principles by which the Creator operates. No known species of attraction could produce such a result.

The vegetable world is full of novelty and wonders; and nowhere do we discover more than in the diversity of properties and characteristics, which exists in the juices or sap of plants and trees. In one tree, as the pine, we discover a terebinthinate fluid, sticky and hot to the taste. In another, as the maple, a sweet fluid, remarkable for its liquidity. In a third, as the oak, we find an astringent fluid. In a fourth, as the barberry bush, a sour fluid. In a fifth, as the milk-weed, a thick, white, soporific fluid. In a word, the sap of trees and plants is almost as various in its medicinal and sensible properties as is their species. In the animal kingdom, the blood, the sap of the animal, in all the great variety of species, varies but little, either in its sensible or chemical properties. This uniformity in the vital fluid argues a greater uniformity of organization in the animal than in the vegetable world. The variety of properties in vegetable sap must arise from a glandular structure of the roots. To what other organization can we attribute the difference between the sap of one tree or plant and another? The roots of the pine are nourished by the same substances as those of the oak, maple and milk-weed; but behold the difference in the substances eliminated! The same glandular structure is manifested in the fruit of trees and plants. In truth, not only the roots and fruit of trees and plants seem to possess a glandular structure, but each and every part betrays a share of it. **This action, by its nature, what it may, evidently**